

IAP20 Reg'd PCT/PTO 15 DEC 2005

## CLAIMS

1. An engine unit, particularly for urban transport, comprising an engine (3) supplied with a compressed gas and having an expansion chamber (9) provided with a piston (6) arranged for completing cyclically a power and an exhaust stroke at each double stroke, a liquid gas tank (28) in communication with the engine (3), and means (M, M') for gasifying the liquid gas, which are interposed between the liquid gas tank (28) and the engine (3) for obtaining compressed gas, the gasifying means (M) comprising a gasification chamber (22) in communication with the liquid gas tank (28) and a liquid fuel tank (39) which is connected to the gasification chamber (22), characterised in that the gasification chamber (22) is in fluid communication with both the liquid fuel tank (39) for the combustion of the liquid fuel with the oxygen of the liquid gas (22), and the expansion chamber (9) so that a gas mixture comprising compressed liquid gas and gaseous products of combustion process are used to do useful work.
2. An engine unit according to Claim 1, characterised in that said expansion chamber (9) is provided with an intake valve (12) and that a duration (AB) for opening the intake valve (12) is selected so that the gas mixture, at the end of the piston power stroke, has substantially attained ambient pressure and temperature.
3. An engine unit according to claim 1 or 2, characterised in that said expansion chamber (9) is provided with an exhaust valve (13) and that a duration (CD) for opening the exhaust valve (13) is selected so that, at the end of the piston exhaust stroke, when the intake valve (12) has to open, substantially the same pressure as in the gasification chamber (22) prevails in the expansion chamber (9).
4. An engine unit according to Claim 1, characterised in that the gasifying means (M) comprise a heat exchanger (33) between the liquid gas tank (28) and the gasification chamber (22), for a starting gasification of the liquid gas.
5. An engine unit according to Claim 1 or 4, characterised in that the liquid gas is of liquid air or of air depleted of oxygen.
6. An engine unit according to Claim 1 or 4, characterised in that the liquid gas is liquid nitrogen.
7. An engine unit according to Claims 6, characterised in that the gasifying means (M') comprise an oxygen tank (128) in communication with the gasification chamber (22) for combustion of the liquid fuel.

SNC002BWO

- 2 -

8. An engine unit according to Claim 1, characterised in that the liquid fuel is liquid hydrogen.
9. An engine unit according to Claim 1, characterised in that the gasifying means (M) comprise a pilot igniter (50,64) inside the gasification chamber (22) to promote the combustion.
10. An engine unit according to Claim 1, characterised in that the gasifying means (M) comprise a pump (31) between the liquid gas tank (28) and the gasification chamber (22).
11. An engine unit according to Claim 1, characterised in that it comprises a pump (42, 56) between the liquid fuel tank (39) and the gasification chamber (22).
12. An engine unit according to Claim 7, characterised in that it comprises a pump (131) between the oxygen tank (128) and the gasification chamber (22).
13. An engine unit according to Claims 10, 11 and 12, characterised in that the pumps (31,42,56,131) are variable delivery pumps used for controlling the engine (3) speed.
14. An engine unit according to Claim 1, characterised in that it comprises a heat exchanger (44,58) between the liquid fuel tank (39) and the gasification chamber (22) for a starting gasification of the liquid fuel.
15. An engine unit according to Claim 1, characterised in that the gasification chamber (22) is split into a first gasification chamber (26) and a second gasification chamber (27) for combustion of the liquid fuel with the oxygen under conditions of saturated steam and overheated steam respectively.
16. An engine unit according to Claim 1 or 4, characterised in that the gasification chamber is to a first gasification chamber (222, 322) which is in fluid communication with an oxygen tank (128) and with the fuel tank (39) and into a second gasification chamber (227, 326) which is in fluid communication with the liquid gas tank (28), the first gasification chamber (222, 322) and the second gasification chamber (227, 326) being under thermal exchange condition for exchanging the combustion heat produced between the oxygen and the fuel.
17. An engine unit according to Claim 16, characterised in that the first gasification chamber (222) and the second gasification chamber (227) are in fluid communication through a thermal exchange chamber (226).
18. An engine unit according to Claim 16, characterised in that the second gasification chamber (326) is directly inserted inside the first gasification

SNC002BWO

- 3 -

chamber (322).

19. An engine unit according to Claim 1, characterised in that the engine (3) comprises an intake valve (12), which is controlled to close for a predetermined duration (AB).

5 20. An engine unit according to Claim 1, characterised in that the engine (3) comprises an exhaust valve (13), which is controlled to close for a predetermined duration (CD).

21. A method for supplying an engine (3) particularly for urban traction, comprising the step of gasifying a liquid gas thus obtaining compressed gas, characterised in that the gasification is achieved by combustion of a  
10 predetermined limited amount of a liquid fuel and oxygen contained in the liquid gas, so that combustion is performed in the same area where the gasification of liquid gas takes place and the engine (3) is supplied with the compressed gas and with gaseous products of combustion process.

15 22. A method according to Claim 21, characterised in that the gasification is achieved by a heat exchanger extracting heat from the ambient atmosphere.

23. A method according to Claim 21, characterised in that the liquid gas is of proper liquid air or liquid air depleted of oxygen, and that the  
20 combustion is performed with oxygen of the liquid air.

24. A method according to Claim 21, characterised in that the liquid gas is of nitrogen and that the combustion is performed with oxygen autonomously supplied with respect to the liquid gas.

25 25. A method according to Claim 21, characterised in that it comprises a further gasification step of the liquid gas which takes place in a distinct gasification area where the oxygen and fuel combustion is performed, and that the combustion heat is conveyed into the gasification area.

26. A method according to Claim 21, characterised in that the liquid fuel is liquid hydrogen.

30 27. A method according to Claim 21, characterised in that the combustion takes place in the presence of a pilot igniter.

28. A method according to Claim 21, characterised in that the predetermined limited amount of the liquid fuel is selected to obtain compressed gas at a predetermined pressure comprised between 10 and  
35 30 atmospheres and preferably 20 atmospheres.

29. A method according to Claim 21, characterised in that it comprises the step of performing a starting gasification of the liquid fuel in a heat exchanger (44,58).

SNC002BWO

- 4 -

30. A generator for supplying an engine (3), particularly an engine for urban traction and the like, comprising a liquid gas tank (28) and gasifying means (M, M') for gasifying the liquid gas into compressed gas, the gasifying means (M) comprising a gasification chamber (22) in fluid communication with the liquid gas tank (29) and a liquid fuel tank (39) which is connected to the gasification chamber (22), characterised in that the gasification chamber (22) is in fluid communication with both the liquid fuel tank (39) for combustion of the liquid fuel with the oxygen of the liquid gas, and a cylinder (5) of the engine (3) through a compressed gas intake valve (12), so that compressed liquid gas and gaseous products of combustion process are used to do useful work.
31. A generator according to Claim 30, characterised in that the gasifying means (M) comprise a heat exchanger (33) between the liquid gas tank (28) and the gasification chamber (22) for a starting gasification of the liquid gas.
32. A generator according to Claim 31, characterised in that the liquid gas is of liquid air or of liquid air depleted of oxygen.
33. A generator according to Claim 30, characterised in that the liquid gas is liquid nitrogen.
34. A generator according to Claims 33, characterised in that the gasifying means (M') comprise an oxygen tank (128) in fluid communication with the gasification chamber (22) for combustion with the liquid fuel.
35. A generator according to Claim 30, characterised in that the liquid fuel is liquid hydrogen.
36. A generator according to Claim 30, characterised in that the gasifying means (M) comprise a pilot igniter (50,64) within the gasification chamber (22) to promote the combustion.
37. A generator according to Claim 31, characterised in that the gasifying means (M) comprise a pump (31) between the liquid gas tank (28) and the gasification chamber (22).
38. A generator according to Claim 31, characterised in that it comprises a pump (42,56) between the liquid fuel tank (39) and the gasification chamber (22).
39. A generator according to Claim 34, characterised in that it comprises a pump (131) between the oxygen tank (128) and the gasification chamber (22).
40. A generator according to Claims 36, 38 and 39, characterised in that the pumps (31,42,56) are variable delivery pumps for controlling the

SNC002BWO

- 5 -

engine (3) speed.

41. A generator according to Claim 31, characterised in that it comprises a heat exchanger (44,58) between the liquid fuel tank (39) and the gasification chamber (22) for a starting gasification of the liquid hydrogen.

5 42. A generator according to Claim 34, characterised in that the gasification chamber (22) is split into a first gasification chamber (26) and a second gasification chamber (27) for combustion of the hydrogen with the oxygen of the air under conditions of saturated steam and overheated steam respectively.

10 43. A generator according to Claim 30, characterised in that the gasification chamber (22) is split into a first gasification chamber (222, 322), which is in communication with the fuel tank (39) and with an oxygen tank (128), and a second gasification chamber (227, 326), which is in fluid communication with the liquid gas tank (28), the first gasification  
15 chamber (222, 322) and the second gasification chamber (227, 326) being under thermal exchange conditions for exchanging the combustion heat produced between the oxygen and the fuel.

20 44. A generator according to Claim 43, characterised in that the second gasification chamber (326) is directly inserted inside the first gasification chamber (322).

SNC002BWO

AMENDED SHEET